Dynamic Trust Management (DTM)

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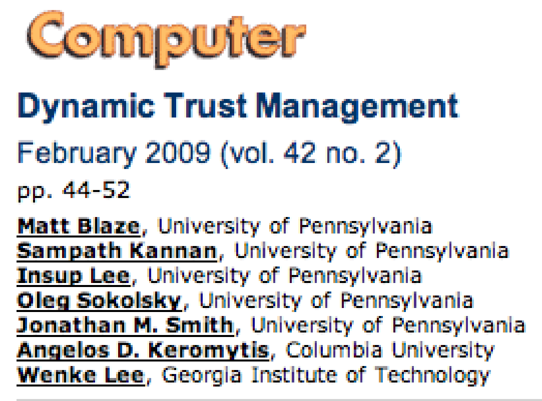
ONR MURI N00014-07-1-0907

Review Meeting

November 4, 2009

Dynamic Trust Management



Computer

Dynamic Trust Management

February 2009 (vol. 42 no. 2)

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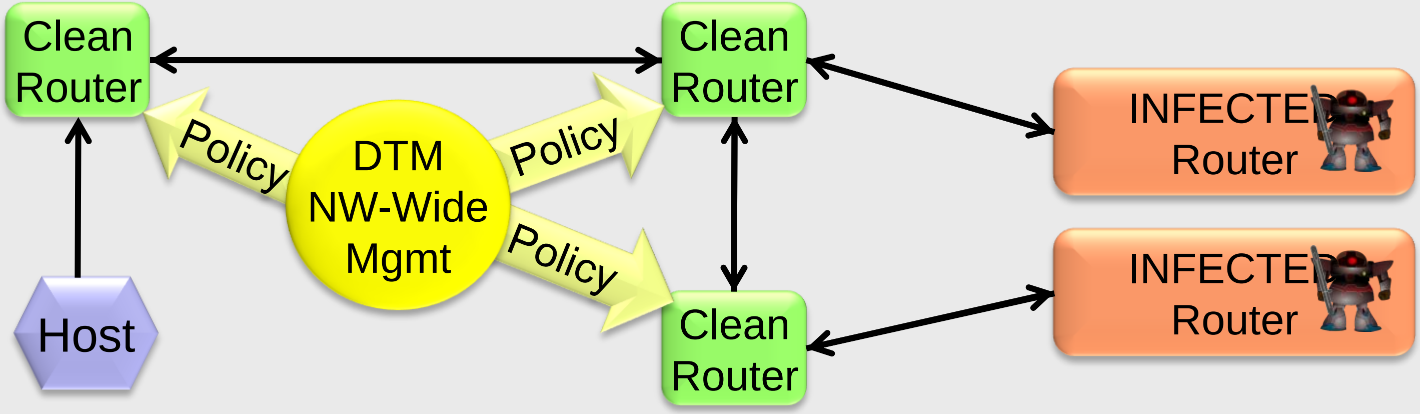
- A COOPERATIVE and DYNAMIC policy evaluation infrastructure enables such critical capabilities as:
  - Adaptation to dynamic service availability
  - Complex situational dynamics (e.g., differentiating between botnet and physical attacks on infrastructure).
- BENEFITS of a Dynamic Trust Management (DTM) approach
  - Flexible and robust control of authorizations in complex distributed systems such as the DoD/IC GIG, Navy FORCEnet and Clouds
  - The ability to define policies for scalable decentralized defense against emergent cyber-threats by rapid adaptation of resource access limits.

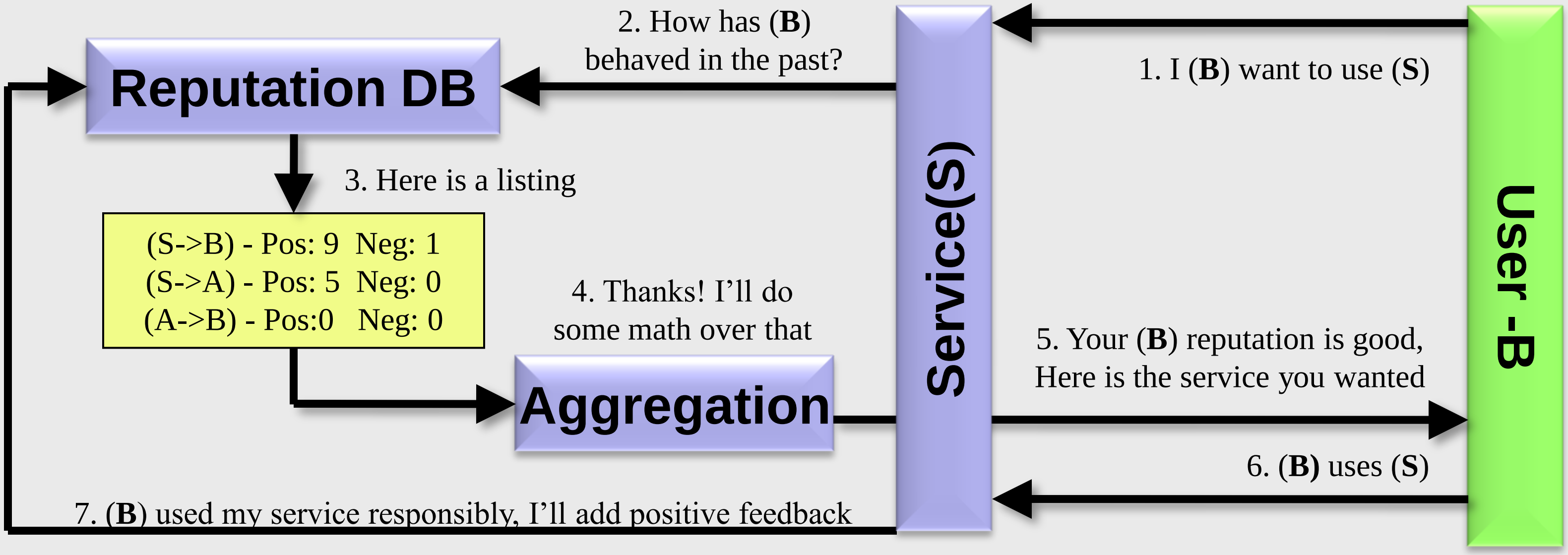


MURI Challenges for DTM to address

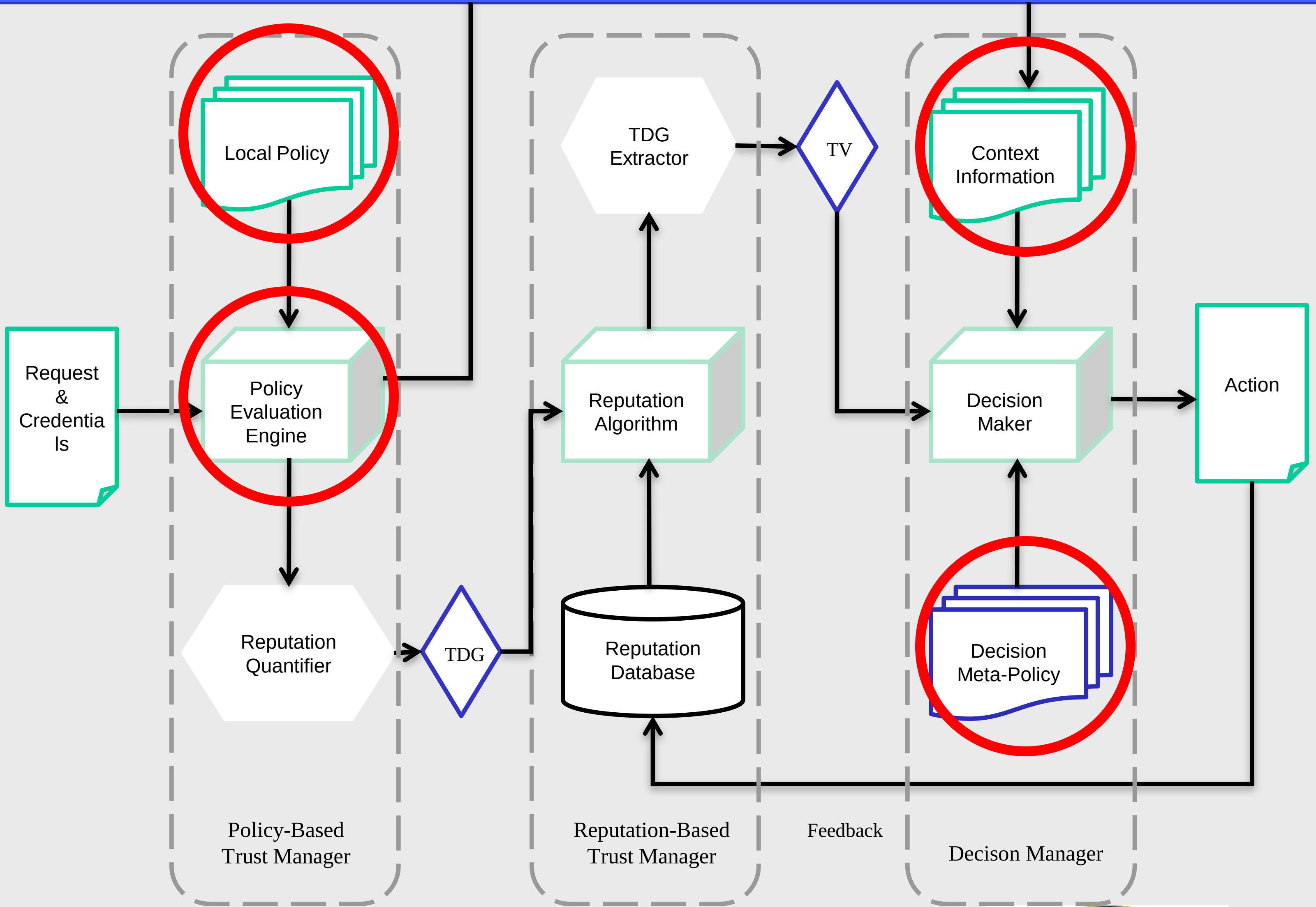
- TM policies are static; centralized compliance chk
  - Situations are dynamic (policies + principals)
  - Situations are distributed
- What is needed?
  - *Dynamic policies* to reflect situation dynamics
  - *Reputations* for principal dynamics
  - *Cooperative architecture* suited to GIG, Navy FORCEnet and emerging Cloud Computing
- Can we make it usable and perform well?

Reputation-Based TM (RTM)

- Trust valuation based upon prior interaction history between two parties
  - Discovers new trust relationships based on partial, uncertain information
  - Accounts for indirect interactions
  - Combines multiple trust chains
  - Captures a degree in [0,1] that A trusts B
  - Uses feedback to dynamically adjust reputation values

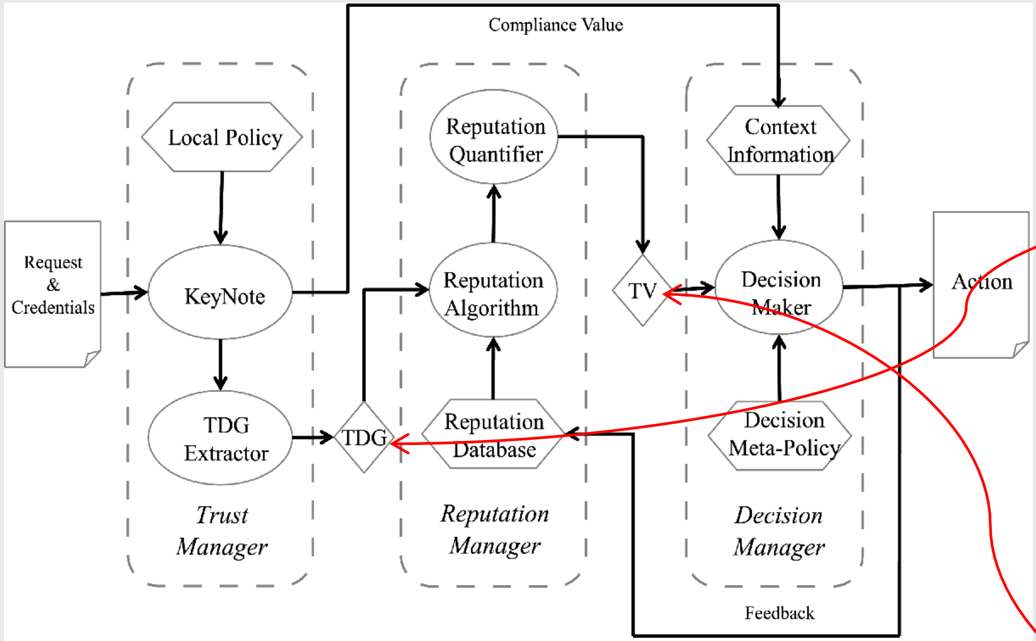

Reputation DB
2. How has (**B**) behaved in the past?
Service(S)
User -B
1. I (**B**) want to use (**S**)
3. Here is a listing
(S->B) - Pos: 9 Neg: 1
(S->A) - Pos: 5 Neg: 0
(A->B) - Pos:0 Neg: 0
4. Thanks! I'll do some math over that
Aggregation
5. Your (**B**) reputation is good, Here is the service you wanted
6. (**B**) uses (**S**)
7. (**B**) used my service responsibly, I'll add positive feedback

DTM enables and exploits QTM

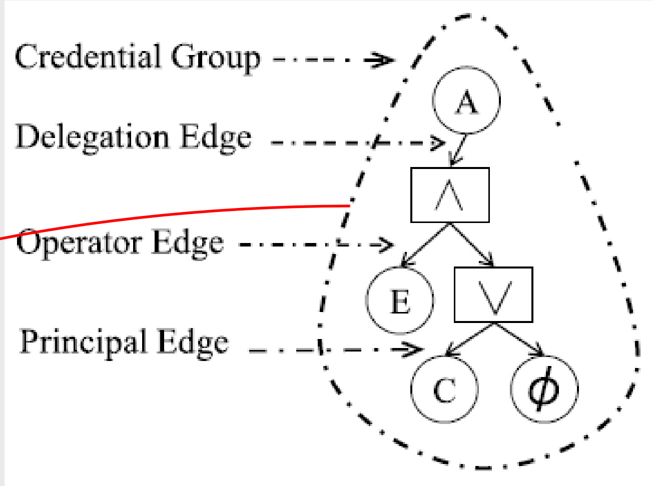


A QTM instantiation: QuanTM

- QTM provides a *dynamic* interpretation of authorization policies for access control decisions using evolving reputations of parties
- *QuanTM* is a QTM system that combines elements from PTM and RTM to create a novel method for trust evaluation



The QuanTM Architecture



Trust Dependency Graph (TDG), encoding PTM relationships useful for RTM

Reputations of PRINCIPALS, DELEGATIONS and CREDENTIALS are aggregated

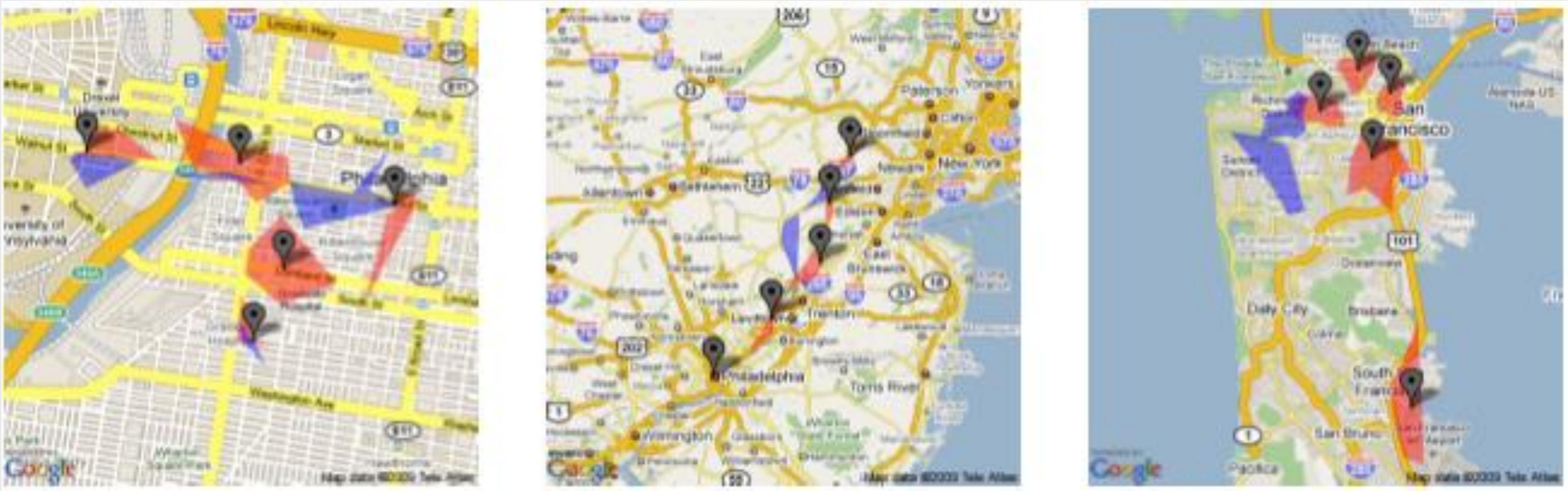
QuanTM Implementation Status

Module Based, plug and play

- KeyNote as Policy Language
  - New Python Implementation ~4000 lines
    - http://experience2.org/wiki/index.php?n=EzPyKeynote.EzPyKeynote
  - Outputs CV and TDG in XML format
- Mysql as Reputation Database
- TNA-SL as Reputation Logic
  - New Java Implementation ~4000 lines
  - Inputs: TDG, Reputation DB; Output: Trust Value
    - http://rtg.cis.upenn.edu/qtm/quantm.php3

Performance: *policy stability*

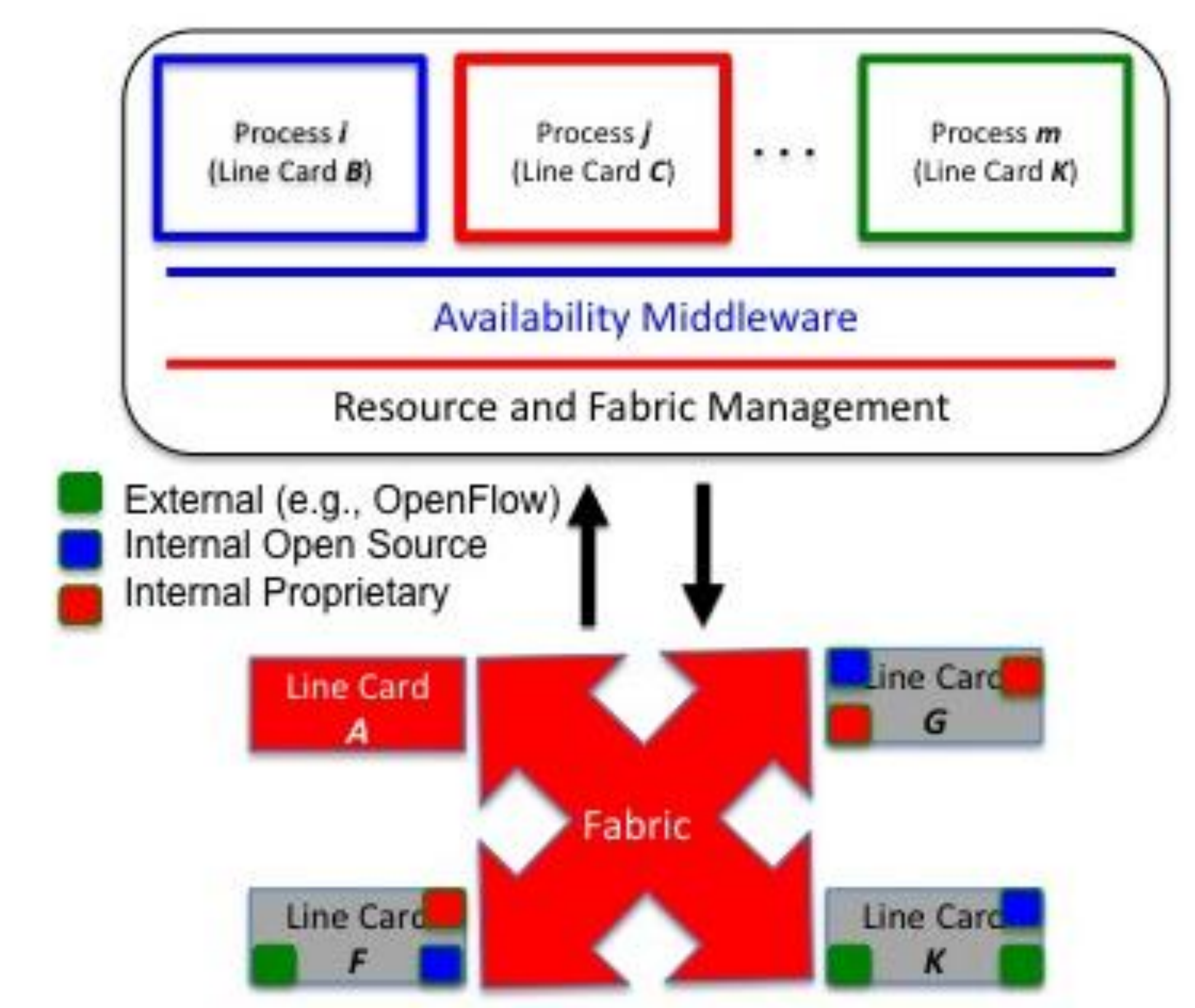
- Location tracking of smartphone users shows:
  - Repeated travels – behavioral patterns
- Therefore, even with DTM, *limited policy churn*!
  - Small set of policies may be enough



DTM Impact

- Influence on router architecture through R3 (next)
  - Working on module distribution
- Influence on malware defense policies
  - Working on detection/mitigation w/ISP #1
- Influence on botnet defense policy deployment
  - Working on cooperative detect/mitigate, ISP #2
- Influence on DARPA Intrinsically-Assurable Mobile Ad-Hoc Network (IAMANET) Zodiac project

DTM Outreach: R3* Architecture



* R3 is Router Reliability Research and is described in a white paper available at http://r3.cis.upenn.edu Penn, Cisco, Cornell, Delaware, MIT, Purdue and Vrije Universiteit are currently involved

Work in MURI Continuation

- QuanTM-managed Wiki as test application
  - Test of QTM’s fused policies and reputations
- Demonstrate use in novel botnet defenses
  - Use QuanTM to check data access
  - Use QuanTM to check policy downloads
- Real-world data to examine issues at scale
  - Dynamics from internal and ISP traces
- Tech transfer to router vendors and ISPs